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ABSTRACT

This paper presents the causal comparative method, or ex post facto research design, as an alternative to classical experimental methods for establishing causal relationships between events and circumstances. A literature survey, conducted in an effort to define and describe the method is discussed. Following this is a presentation of the relationship between the correlation method and the causal comparative method. Both the strengths and weaknesses of the ex post facto research designs are detailed. (WDR)

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EXPOST FACTO STUDIES AS A RESEARCH METHOD

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ABSTRACT

Employing the experimental method in research is sometimes impractical or prohibitively costly in time, money, and effort; in other instances, it is unethical or immoral. The causal comparative method or ex post facto research design, outlined in this paper, is an alternative method for establishing causal relationships between events and circumstances. The literature was surveyed in an effort to define and describe the method. The relationship between the correlation method and the causal comparative method is also discussed. Both the strengths and the weaknesses of ex post facto research designs are detailed.

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SPECIAL REPORT No. 7320
COMPUTER-BASED PROJECT for the EVALUATION of MEDIA for the HANDICAPPED

Title: "EXPOST FACTO STUDIES AS A RESEARCH METHOD"

BY:Harold G. Lord

BACKGROUND

The Computer Based Project for the Evaluation of Media for the Handicapped, based on contract #OEC-9-423617-4357 (616) between the Syracuse (N.Y.) City School District and the Media Services and Captioned Films Branch, Bureau of Education for the Handicapped (United States Office of Education) for the five year period July 1, 1969 through June 30, 1974. The major goal is to improve the instruction of handicapped children through the development and use of an evaluation system to measure the instructional effectiveness of films and other materials with educable mentally handicapped (EMH) children, in-service training and media support for special teachers, and studies related to the evaluation process and the populations used.

The Project has concentrated on the 600 films and 200 filmstrips from the Media Services and Captioned Films (BEH - USOE) depository; however, specific packages from Project LIFE, various elementary math curricula, and selected programs from Children's TV Workshop have also been evaluated. The evaluation model used requires that: 1) objectives of materials be specified and written; 2) instruments be constructed to test and measure effectiveness; and, 3) children be the major sources of evaluation information. A number of instruments and methodologies are employed in the gathering of cognitive and affective data from 900 EMH children and 80 special teachers to make the effectiveness decisions. Over half of the EMH population can neither read or write; therefore, a unique Student Response System (SRS) is employed, consisting of a twenty station G.E.-1000 SRS which can be operated in a group or individual recording mode and is connected to a remote computer system. The computer capabilities consist of remote telephone connections to the Rome (N.Y.) Air Development Command, the Honeywell time-shared network, and the Schenectady (N.Y.) G E Research and Development Center; and batch mode capabilities of the Syracuse City Schools, Syracuse University, and various commercial sources.

In-service and media support activities provide on-the-job training for teachers, teacher aides, equipment, and materials to the special teachers in the city schools. The research activities have centered around investigations and special problems related to the development of the evaluation model. The four major areas considered are: 1) testing effects, 2) captioning effects, 3) special student characteristics; and, 4) evaluation procedures validation.

Documentation of the major activities appear in the five annual reports and the 600 evaluations prepared on materials used. Staff members were encouraged to prepare special reports and the attached paper is one of these. The opinions expressed in this publication do not necessarily reflect the position or policy of the Computer Based Project, the United States Office of Education, or the Syracuse City School District, and no official endorsement by any of the agencies should be inferred.

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Experimental educational research has been derived from the laboratory method often used in the natural sciences. According to Galfo and Miller (1970) in its most elementary form, the experimental method of science is based upon two assumptions regarding variables which may be identified with the phenomenon under investigation:

> 1. If two situations are equal in every respect except for a factor present in one of the situations, any difference which appears between the two situations can be attributed to the factor. This statement is referred to as the law of the single variable.
> 2. If two situations are not equal but it can be demonstrated that none of the variables are significant in producing the phenomenon under investigation; or if significant variables are made equal, any difference occurring between the two situations after the introduction of a new variable to one of the systems can be attributed to the new variable. This statement is referred to as the law of the only significant variable [p. 17].

The purpose of establishing experimental-control conditions is to create a situation in which the effect of a single variable can be studied.

In the behavioral sciences many problems cannot be solved by the experimental method. Because of the complexity and nature of social phenomena, one cannot always select

and control the factors necessary to study cause and effect relations in an artificial laboratory situation. If an experimenter controls variations in all but a single independent-experimental-variable, he may prevent the simultaneous functioning of variables that normally are found operating together and thus may free the independent variable from the influence of the other variables. In such instances an analysis of what actually does happen in a natural situation may be a more satisfactory way to study causes.

Employing the experimental method is sometimes impractical or prohibitively costly in time, money, and effort in some instances, such as studies of riots or "life as it is lived." In other instances employing the experimental method is unethical or immoral. One cannot justify staging fatal airplane crashes to ascertain their causes, or placing emotionally stable children in controlled environments to determine whether it is possible to produce various psychoses. Respect for living things thus prevents an investigator from inflicting unnecessary pain, hardship, or harm on others, or from interfering in any way with the normal growth and development of an individual. Hence, in some cases, experiments cannot be utilized to study causation; thus, one must turn to

the causal comparative method or the ex post facto research design.

Causal Comparative Method

According to Van Dalen (1962) the causal comparative method of research provides insights into life situations:

> Instead of arranging a controlled laboratory experiment and inducing subjects to do or become something, a researcher studies a life situation in which subjects are playing, experiencing, or being what he wants to investigate. To study school integration riots, for example, rather than setting up an experiment to test whether various factors will cause a riot, he compares a community that has experienced a riot with one that has not. After studying the likenesses and differences between the two situations, he describes the factors that appear to account for the riot in the one instance and not in the other [p. 201].

A search is made for factors or conditions which seem to be associated with one group and not the other that might serve as a possible explanation of the underlying causes.

The causal comparative method or ex posto facto method of research seeks to establish causal relationships between events and circumstances. In other words, it finds out the cause of certain occurrences or non-occurrences. This is achieved by comparing the circumstances associated with observed effects and by noting the factors present in the in-

stances where a given effect occurs and where it does not occur. Sukhia, Metrotra, and Metrotra (1966) placed the method in historical perspective within logic:

> This method is based on Mill's Canon of Agreement and Disagreement which states that causes of a given observed effect may be ascertained by noting elements which are invariable present when the result is present and which is invariably absent when the result is absent [p. 215].

The causal-comparative approach differs from the historical, the normative-survey, and the experimental in various respects. Historical research may also seek to find out the causes of events, but while historical research finds out the causes of past events, the causal-comparative deals with the present events only. Normative-survey deals with present events, and it is mainly concerned with status and trends, not the causes of educational effects. The causal comparative method differs from the experimental procedure in that it does not control the variable factors. It, instead, makes observations under normal field conditions and discovers the causes of observed phenomena.

Definition of Ex Post Facto

Kerlinger (1964) defined ex post facto research as:

> that research in which the independent variable or variables have already occurred and in which the researcher starts with the observation of a dependent variable or variables. He then studies the independent variables in retrospect for their possible relations to, and effects on, the dependent variable or variables (p. 360).

Ary, Jacobs, and Razavieh (1972) suggested that the basic purpose of ex post facto research is to discover or establish causal or functional relationships among variables, and that "careful investigators prefer to speak of functional rather than causal relations (p. 264)."

Tuckman (1972) defined the term ex post facto to be:

> an experiment in which the researcher examines the effects of a naturalistically-occurring treatment after that treatment has occurred rather than creating the treatment itself. The experimenter attempts to relate this after-the-fact treatment to an outcome or dependent measure. While the naturalistic or ex post facto experiment may not always be diagrammed from other designs, it is different in that the treatment is included by selection rather than manipulation. For this reason, it is not always possible to assume a simple causative relation between independent and dependent variables. If the relationship fails to be obtained, then it is likely that no causative relationship holds. But if the predicted relationship is obtained, this does not necessarily mean that the variables studies are causally related (pp. 123-124).

Elements of the Method

The sequence of steps involved in ex post facto research were set forth by Isaac and Michael (1971), and they include:

1. Define the problem.
2. Survey the literature.
3. State the hypotheses.
4. List the assumptions upon which the hypotheses and procedures will be based.
5. Design the approach:
   a. Select appropriate subjects and source materials.
   b. Select or construct techniques for collecting the data.
   c. Establish categories for classifying data that are unambiguous, appropriate for the purpose of the study, and capable of bringing out significant likenesses or relationships.
6. Validate the data-gathering techniques.
7. Describe, analyze, and interpret the findings in clear, precise terms [p. 23].

Sukhia, Metrotra, and Metrotra (1966) listed three important aspects of the causal-comparative method in regard to its treatment of data:

1. gathering of data on factors invariably present in cases where the given result occurs and discarding of those elements which are not universally present;
2. gathering of data on factors invariably present in cases where the given effect does not occur; and
3. comparing the two sets of data, or in effect, subtracting one from the other to get at the causes responsible for the occurrence or otherwise of the effect [p. 215].

By their very nature, ex post facto experiments can provide support for any number of different, and perhaps contradictory, hypotheses; they are so completely flexible that it is largely a matter of postulating hypotheses according to one's personal preferences. The point is that the evidence simply illustrates a hypothesis; it does not test the hypothesis since hypotheses cannot be tested on the same data from which they were derived. The relationship noted may actually exist but it is not necessarily the only relationship, or perhaps even the crucial relationship.

This does not mean that the ex post facto experiment is completely worthless; many of our important studies in education and psychology are ex post facto studies. On the other hand, their failure to introduce the common elements of control, randomization, etc. makes them extremely vulnerable from a scientific point of view and the danger of their being misleading should be clearly recognized. Ex post facto "experiments" are probably better conceived as surveys, useful in the derivation of hypotheses to be tested through more conventional experimental approaches.

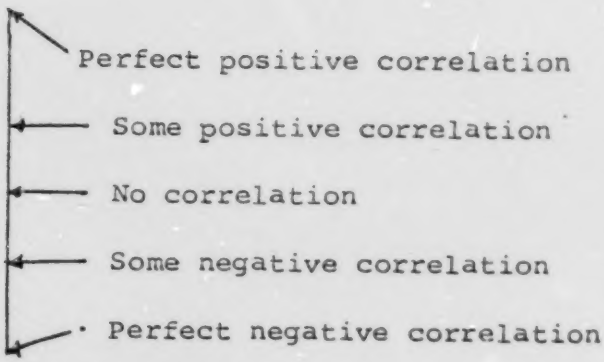
Correlation

Related to the causal comparative method of research is correlation. The correlation method of research is not merely a statistical device of calculating degrees of relationships (coefficients of correlation) between certain data. It is a research approach, which analyses the relationship between data, between variables and some results in such a way that the underlying pattern of relationships becomes clear.

In their discussion of correlation, Weinberg and Schumaker (1969) set forth the following formal definition:

> Two variables are said to <u>correlate positively</u> when, as one variable increases, the other shows some trend to increase correspondingly in a uniform way. Two variables are said <u>not to correlate</u> at all when, as one of them changes, the other shows some trend to decrease correspondingly in a uniform way [p. 248].

Correlation refers to the degree to which two variables move uniformly with respect to each other. Correlation, since it is linear in nature, may be shown graphically as some point on a continuum. If a line were drawn to represent possible correlations, the relationship between any two variable may be shown as some point on that line.



Weinberg and Schumaker stated this warning:

> Remember that when we discuss correlation we are always talking about a trend that exists and not a necessary or invariable relationship. Also remember that the fact that two variables correlate does not at all imply that either variable causes the other to change. In any given case, the relationship may be coincidental or the consequence of some external cause that has not even been discovered [p. 248].

Quas-Experimental Design

Mouly, in his book, The science of educational research (1970), indicated his belief that the ex post facto experiment is of questionable quas-experimental design:

> A relatively questionable quasi-experimental design is the ex post facto experiment, in which a particular characteristic of a given group is investigated with a view to identifying its antecedents. This is experimentation in reverse: instead of taking groups that are equivalent and exposing them to different treatment with a view to promoting differences to be measures, the ex post facto experiment begins with a given effect and seeks the experimental factor that brought it about. The obvious weakness of such an "experiment" is that we have no control over the situations that have already occurred and we can never be sure of how many other circumstances might have been involved [p. 340].

Isaac and Michael (1971) offerred the following strengths and weaknesses for the ex post facto research design:

Strengths

1. The causal-comparative method is appropriate in many circumstances where the more powerful experimental method is not possible:
   a. When it is not always possible to select, control, and manipulate the factors necessary to study cause-and-effect relations directly.
   b. When the control of all variations except a single independent variable may be highly unrealistic and artificial, preventing the normal interaction with other influential variables.
   c. When laboratory controls for many research purposes would be impractical, costly, or ethically questionable.
2. It yields useful information concerning the nature of phenomena: what goes with what, under what conditions, in what sequences and patterns, and the like.
3. Improvements in techniques, statistical methods, and designs with partial control features, in recent years, have made these studies more defensible.

Weaknesses

1. The main weakness of any ex post facto design is the lack of control over independent variables. Within the limits of selection, the investigator must take the facts as he finds them with no opportunity to arrange the conditions or manipulate the variables that influenced the facts in the first place. To reach sound conclusions, the investigator must consider all the other possible reasons or plausible rival hypotheses which might account for the results obtained. To the extent that he can successfully justify his conclusions against these other alternatives, he is in a position of relative strength.

2. The difficulty in being certain that the relevant causative factor is actually included among the many factors under study.
3. The complication that no single factor is the cause of an outcome but some combination and interaction of factors go together under certain conditions to yield a given outcome.
4. A phenomenon may result not only from multiple causes but also from one cause in one instance and from another cause in another instance.
5. When a relationship between two variables is discovered, determining which is the cause and which the effect may be difficult.
6. The fact that two, or more, factors are related does not necessarily imply a cause-and-effect relationship. They all simply may be related to an additional factor not recognized or observed.
7. Classifying subjects into dichotomous groups (e.g., "Achievers" and "Nonachievers"), for the purpose of comparison, is fraught with problems, since categories like these are vague, variable, and transitory. Such investigations often do not yield useful findings.
8. Comparative studies in natural situations do not allow controlled selection of subjects. Locating existing groups of subjects who are similar in all respects except for their exposure to one variable is extremely difficult [pp. 22-23].

In a philosophical discussion of causation, Broudy, Ennis, and Krimerman (1973) stated:

> Causation is a thorny topic for educational researchers, yet one that we must face, and face squarely. We know how easy it is to commit the post hoc falfacy: to think that just because something followed or follows something else, it was or is caused by that something else; so we are justifiably cautious about making causal allegations. But sometimes this caution is carried to the extreme: complete avoidance of the use of the word "cause" (often self-defeatingly accompanied by use of terms with similar

> meaning, like "brings about," or "produces," or accompanied by an ambiguous statement of the conclusion so that it is obvious if noncausal, but not explicitly causal in nature [p. 401].

Even with its weaknesses, the ex post facto research design plays an important role in understanding mankind. Broudy, Ennis, and Krimerman (1973) summarized their concern for causal relationships:

> We cannot avoid concern with causal relationships, both general and particular. Education is concerned with bringing about changes, with providing general guidelines for so doing (guidelines that must take the form of causal generalizations), and with particular causal analyses of existing or recent occurrences. Furthermore, a number of educators are interested in knowing when children have developed a concept of causation and/or when they are ready to develop this concept. These practical concerns of the educator require educational researchers to use causal terms. We should be as clear as possible about what we are saying when we make a causal allegation and should have a good idea about what counts as proof and disproof, and support for and opposition to a causal allegation [p. 401].

Kelinger (1964) presented a strong case for the research method:

> It can even be said that ex post facto research is more important than experimental research. This is, of course, not a methodological observation. It means, rather, that the most important social scientific and educational research problems do not lend themselves to experimentation, although many of them do lend themselves to controlled inquiry of the ex post facto kind. Consider the study of the effect of the English eleven-plus examination on English

> children, current studies of children's creativity, Piaget's studies of children's thinking, Gross's studies of boards of education and superintendents, and the authoritarianism studies of Adorno, et al. If a tally of sound and important studies in psychology, sociology, and education were made, it is likely that ex post facto studies would outnumber and outrank experimental studies [p. 373].

He later tempered this position by stating that the weaknesses of the method must be recognized and considered:

> Some students of research believe that much behavioral research, but particularly educational research, suffers from a serious lack of a rigorous experimental approach and that it will lag as long as this situation exists. The author believes that good experimental research is badly needed in all fields, and that large doses of poor ex post facto research should be avoided. Improvements in educational ex post facto research are badly needed. Perhaps a good rule to follow would be to ignore the results of any ex post facto study that does not test hypotheses. Exceptions to this stricture should be few and far between. Perhaps another good rule would be to be highly skeptical of any ex post facto study that tests only one hypothesis; that is, alternative "negative" hypotheses should be routinely tested. Researchers should predict significant relations and nonsignificant relations whenever possible.
>
> A final piece of advice is this: always treat the results and interpretations of the data of ex post facto investigations with great care and caution. Where one must be careful with experimental results and interpretations, one must be doubly careful with ex post facto results and interpretations [p. 373].

Causal comparative studies have many limitations, and they often do not produce the precise, reliable knowledge that

can be gained through good experimental studies. But they do provide a means of tackling problems that cannot be probed in laboratory situations, and they do yield valuable clues concerning the nature of the phenomena. As the techniques, tools, and controls used in conducting causal comparative studies have been improved, this method of inquiry has gained greater respect.

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